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by
James E. Webb, Administrator
National Aeronautics and Space Administration

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NASA AS AN ADAPTIVE ORGANIZATION

These are uncertain and unusual times. The war in Vietnam, the peace talks in Paris, the problems that face our cities, new alarms as to Soviet intentions, the problems of inflation, of the balance of payments, and the uncertainties of an election year -- taken together and interacting -- place us all in a position from which it is most difficult to chart a clear and certain course for the future. Almost every important national and regional enterprise is proceeding through a series of adjustments and readjustments as our economic, political and social systems move to resolve the problems with which we are faced. And most local enterprises cannot go forward independent of national and regional conditions.

The National Aeronautics and Space Administration is no exception. In its research and development activities in aeronautics and space, adjustments to the needs of these times have taken the form of sharp reductions in our budget and programs and the initiation of a series or organizational and personnel changes designed to provide both continuity and vigorous leadership during this period of transition.

In this fiscal year NASA is conducting important tests and flying out a number of vitally important missions started during the buildup period since 1961. With very few exceptions we are not initiating work on new ones. Work on the Apollo program is now nearing the home stretch. We are in the countdown stage for a series of Saturn V flights that will culminate in the first manned moon landing and exploration. Activities in other areas have had to be curtailed, and many projects reduced in scope. Other work has been deferred to future years. I believe NASA will prove that its organizational pattern is an adaptive one.

The development of programs to use the Apollo equipment after the lunar landing for practical uses is funded at less than one-third the amount we had anticipated in our 1969 budget of last January. Therefore, the Apollo applications flight program will be delayed and limited to one Saturn I workshop and one Apollo telescope system, with a backup for each. Work toward post-Apollo lunar exploration and toward an earth orbiting Saturn V workshop will be severely limited. Production of Saturn IB launch vehicles will be terminated, and -- as things now stand -- the production of Saturn V's will be stopped after completion of 15 vehicles.

The plan submitted last January for a Mars mission in 1973 is being revised to conform to our reduced funding levels. The payload to be landed on Mars and the scientific return will be substantially less than was included in our budget request.

In the nuclear propulsion field, development of a flight qualified rocket engine will not begin this year. To preserve an option to initiate this development in fiscal year 1970, a cadre of design and development personnel will be retained. Work in advanced nuclear technology will be continued and one experimental engine will be tested.

In aeronautics, the X-15 and B-70 program of experimental test flights will be terminated. A number of development projects in short and vertical takeoff and in supersonic and hypersonic fields will be phased down.

An overall measure of the burden of adapting the NASA organization to the drastic reductions that are being effected is the fact that by the end of this fiscal year the work force will be down to just over 200,000, a level of about one-half that of three years ago. The 200,000 people who are being extruded from the program are for the most part not government employees -- over 90% of them are in industrial plants and laboratories. This spreads the burden of adaptation quite broadly throughout the aerospace industry.

These reductions in the level of research and development work in the fields of aeronautics and space will have many serious effects on the U. S. position in science and technology, and in time on our status and prospects as a great power. But the ones to which we are adapting this year are only the most recent in a series of cutbacks that constitute in total what may be called a national decision. This decision has been in the making since 1964. It is that the United States will not at this time take the steps necessary to use the trained manpower and capital plant which we have built up to continue the advances of recent years in the scientific and engineering fields essential for success in space and aeronautics.

Looked at in another way, the decision means that the United States is not pursuing, for the time being at least, its goal of "preeminence in space." The USSR is quite evidently stepping up its efforts at the same time that we are curtailing our own. At the time that our production of the large Saturn boosters grinds to a halt, the Soviets will be bringing on stream their large new booster. While our plans for a Saturn V orbiting workshop remain on ice, the Soviets will be able to proceed with their long-heralded, multi-manned and multi-purpose space station. At present levels, the launching of planetary probes and deep space exploration in the early 1970s will be left to the almost exclusive domain of the USSR. The US is accepting for a long time, perhaps for the indefinite future, both the advantage of expenditure reduction and the disadvantages of a second-rate position in space. In aeronautical research and development the situation is not the same, but is still a cause for serious concern.

While I would be remiss if I did not thus emphasize the consequences that will flow from recent decisions, I recognize that the totality of the problems our nation faces reaches far beyond NASA. As responsible government officials, we in NASA accept the result of our nation's decision-making process. We know that our immediate job is to achieve success in the mission started in past years and now nearing completion. We accept the necessity of adjusting our organization, programs, contracts, university grants, and facilities to meet the reductions that have been decided on. In the process, we will do all we can to maintain a firm foundation on which we can build in the future.

As I say this, let me make very clear that NASA is still in business; and it will stay in business. We view what is happening not as a defeat but as a challenge of the times and we are moving to meet this challenge by assuring continuity in our senior management group and continuing a hard-hitting, technically sound program aimed at keeping open a wide range of options for use when the nation decides to resume its advance as a spacefaring nation. We are making the necessary adjustments now and we are also preparing a base for the nation's longer term requirements.

In connection with conditions essential to continuity, I should stress that the events of the past few months, while they have led to reduced levels of support, have nevertheless shown that there exists throughout the country a strong continuing core of support for research and development in both space and aeronautics. When one considers the whole array of problems now facing the Congress and the nation, and the fact that all national programs, needs, and priorities are being adjusted, it must be taken as significant that both the legislative and executive branches are standing firm at a four billion dollar level for the 1969 NASA budget. I think this shows a recognition of the need to continue a major effort in aeronautics and space.

Also, among thoughtful people in the country at large, I do not find a decline in public support for the space program. Rather, many feel we are in a period in which attention has been focused on other serious needs and problems. The problems of how we stand in the world, including our position in Southeast Asia, and the problems faced by the cities have been with us for many years. But it was not until these approached major points of crisis that demands were made for major commitments of resources extending over a long period of years. We in NASA saw much the same thing happen with Sputnik and with Gagarin. This phenomenon has been called "decision by crisis." The result is that many people who in the years following 1961 ascribed to space needs a special, top priority status are now realizing, as the national leadership in the space program has understood all along, that the space program must be regarded as only one of a number of essential activities of high priority to which the country must devote substantial resources. In my opinion, what may appear to some to be a decline in public support is not a changed attitude toward space, but a reflection of a new awareness of other high priority problems and requirements. This may well lead to the recognition that many of the other newly seen problems can best be approached and actions to solve them taken within the framework of NASA's experience with the organization of large scale scientific and engineering efforts. The investments made in NASA may well add greatly to the value of investments we will have to make in these other fields.

Whatever differences there may be among us as to the wisdom of our efforts in space, no one can deny that these have produced results that few would have thought possible a decade ago. In June of 1957 in a commencement address at Colorado College I thought to stimulate the graduates by repeating a speculative timetable for space exploration that Mr. J. S. McDonnell of St.Louis had laid out two weeks before at the Missouri School of Mines. I quoted Mr. McDonnell in these terms:

> "In about a dozen years or so, we will launch a satellite that will circle the earth and moon.
>
> "By about 1980, we will have made sufficient advances to permit the launching of a satellite that will circle the earth and Mars.
>
> "By about 1990, we can go forward to the point of launching a space ship carrying human beings which will circle the earth for an extended period as a satellite and return safely."

Today we all know that in quoting Mr. McDonnell on that June day in 1957, I underestimated what both the USSR and the US could do. Four months later Sputnik flew and in four years Gagarin had circled the earth and returned -- not in the year 1990 but in 1961.

It was just seven years four months and five days ago that President Kennedy summoned this nation to an expanded and accelerated effort to achieve for the United States the status of a spacefaring nation second to none. What has been done in these seven years?

We could spend many hours on the answer to this question. And it would be a pleasant exercise, for I am immensely proud of the record of NASA's performance.

We could review the Mercury program from Alan Shepard through John Glenn to Gordon Cooper. We could show that this involved a tremendous and successful effort to take a military booster and man-rate it, to utilize the capability of the Atlas for astronauts instead of warheads. It would be easy to follow and dwell on Gemini, in which we flew 20 men in 20 months. In Gemini, we learned that men could live and work in space for 14 days, that they could walk in space, that they could join two space vehicles together, and that they could return to earth so accurately that the opening of their parachutes could be seen from a waiting ship.

We could spend much time on advances in space science. It would be easy to point to new findings about our earth and its relationship to the sun, to what we have learned of the moon and of Mars and Venus. In the area of space applications we could list many accomplishments and exciting prospects for bringing truly marvelous new tools to the service of man.

My purpose today precludes this detailed cataloging of space accomplishments. But it is important to get across an understanding of the <u>capabilities</u> we have built up, capabilities that are now in place, are serving our Nation's present needs and will have a long, useful life. A good way to do this is, I believe, to recall with you our launch activities during just one week of last year.

This week was the second in November 1967. Admittedly it was a full week. But what was done can be repeated and on an ever grander scale. The capabilities that made that week possible are lasting capabilities. We may never use those capabilities to the fullest, or even in large part, but they do exist and can be put to use if they are not permitted to deteriorate below the minimum for reactivation.

On Monday, November 6, we launched an Applications Technology Satellite -- the ATS III. This was put into an earth synchronous orbit over the South Atlantic, which means that the satellite hovers twenty-four hours a day over the same spot. It has over the intervening months been sending back color pictures of the earth and its atmosphere and serving as an experimental communications relay station. This machine will stay in position for a long time. It is continuously adding to our knowledge of the earth, its weather, the effects of the sun's energy on nature's processes here on earth, and how to increase efficiency in long distance communications.

The ATS III is the third member of the third generation of experimental weather observation satellites which have been launched within a five-year period. It ia also a member of the fifth generation of communications satellites, all launched since 1961.

In understanding and predicting weather, the measurements made by the ATS and other NASA experimental spacecraft, added to the twenty-four hours per day regular operations now performed by ESSA's space systems, are even at this early time in space development providing a handsome return on the time and money invested. Some continually transmit cloud-cover pictures as they circle the earth and any weather station in any nation or on any ship has only to use an inexpensive receiver to get this up-to-the-minute and on location weather information. This is one way our country says to every other country, every day, that we as a people want to use our new power over the forces of nature in a joint effort with them, with benefits to both of us, and not to threaten or to coerce them to follow some pattern laid down by us. It is our way of saying that we want to develop power together with them, not power over them.

Well, let's leave Monday and go to Tuesday, when our second launch of the week was Surveyor VI. Two days after launch this second generation lunar spacecraft made a soft landing on the moon and promptly began to transmit detailed pictures of a very rugged stretch of the lunar surface. This launch was one of a series of unmanned launches of automated systems that included Ranger and Lunar Orbiter, as well as Surveyor. You will remember the Rangers came directly in for a crash landing, taking large numbers of pictures of a limited area right up to the point of contact. Many of you, I suspect, saw the broadcast of the first Ranger coming in and heard that dramatic announcement, "live from the moon." The Ranger pictures provide astronomers with the equivalent detail of a telescope a thousand times more powerful than any previously available. As to Lunar Orbiters, there have been five, all of which were outstandingly successful. They circled the moon at about 27 miles, with the result that we now have a complete map of the moon, both front and back, with excellent resolution. We can now study any particular place for landing astronauts or to advance scientific knowledge.

The Surveyors are the soft-landers. They round out the work of the Lunar Orbiter and the Ranger. You have seen them on your television digging holes on the moon, making chemical analysis of the soil, blasting small craters with their jet engines. Surveyor VI that we launched on Tuesday, the 7th of November, 1967, was moved from one place to another -- in the first, very short but significant rocket flight on the surface of the moon, moving eight feet. Just as the Ranger pictures provide details 1,000 times more precise than earth-based telescopes, Surveyor pictures provide astronomers with a further improvement in resolution, by another factor of 1,000 times. So, with Ranger and Surveyor, the improvement in magnification is a thousand times a thousand, or a million. With this kind of new capability, the way is open for lunar and planetary investigations of a type and scope undreamed of before we learned to use the rocket technology. With this new capability, man will undoubtedly reach in close to the sun and out to the most distant regions of the solar system. In much the same way, rocket-launched instruments can provide data on cosmic rays, solar plasmas, the magnetic fields in space, and the relationships of these to the earth's magnetosphere.

Let us go on to Thursday, November 9, for the truly big shot of the week: the first test-launch of the Saturn V. This test was to make sure that this powerful booster could develop the full 7.5 million pounds of thrust which we will need when our Apollo astronauts start their round-trip journey to the moon or when we decide to send a 10,000 pound payload to Mars. A second objective was to make sure that the heat shield on the Apollo spacecraft could withstand the temperature, deceleration, and pressures of reentry into the earth's atmosphere at 25,000 m.p.h. A third was to make sure that the 500 million dollar Saturn-Apollo launch complex at Cape Kennedy and the global tracking and data acquisition network we have been building could handle the job of automatically launching this gigantic machine and remotely controlling its complex mission.

This Saturn V launch of November 9 demonstrated that we can have, when we decide to activate it, the big-booster capability and the launch rate capability in which we have been behind the U.S.S.R. It gave us assurance that the Apollo spacecraft can guide itself to a precise point of return and survive a reentry heat that is almost two times the melting point of steel, about 5,000° F. It gave us assurance that the design, the construction andthe equipping of both the space and ground segments of the Saturn-Apollo System had been well done by the tens of thousands of construction and other workers put on the job by American industry.

Let us now turn to the last launch of the week--ESSA IV--on Saturday, November 11. This launch was from the Western Test Range in California. ESSA IV was launched into an orbit that passes near both the North and South Poles and is so synchronized with the rotation of the earth that it can observe and report on the entire earth's weather in daylight every 24 hours. This is known as a polar-retrograde orbit, so that as the earth turns the satellite progresses backward just enough so that it always passes over a point on the earth in maximum sunlight to take its pictures and make its measurements. This is also called a sun-synchronous orbit. The ESSA IV launch differs from the three launches described above in that it exemplifies not the pioneering we do at the frontier of technology and science, but the way in which space operations have become a routine contributor of essential services for the benefit of everyone. ESSA IV is a standard workhorse machine which the U.S. Weather Bureau uses in its day to day task of studying and forecasting the weather. It uses this satellite just as it uses weather reporting ships, planes and balloons. However, the utility of ESSA IV is far beyond any we can achieve in any other way. It works 24 hours a day, all around the world, and feeds information into something like 296 stations in the United States and about 86 in 45 other countries. It is truly a working bird.

The space capabilities demonstrated in the second week of November 1967 represent -- or can be parlayed into -- better than 90% of everything we would need to carry out almost any mission that even the most daring have placed on our space agenda for the next decade. The Saturn V-Apollo system for example, permits us to operate as far out as the moon with payloads of about 100,000 pounds. This distance requires about 98% of the energy it would take to operate out to any other place in the solar system; and it enables us to use all of the maneuvers needed anywhere in space -- the launch from earth, orbit around the earth, propulsion and guidance to reach another body in space, ability to slow down and go into orbit around another body, to land a payload on the surface of that body, and to return to earth either a part of the payload or the scientific measurements obtained.

How important are these capabilities? There are many different views on this question. Formy own part, I have no hesitancy as to my answer: I do not believe our Nation could have long continued as a great power if we had not built up the means to conduct operations in space -- if we had instead conceded a monopoly of this new dimension of man's activity to the USSR or any other country. I believe we would have sacrificed our chances to keep pace in the technological competition that is the crucial test of our times. We would have turned out backs on the opportunities space offers for large extensions of scientific knowlege. We would have denied to ourselves the tools and the knowledge necessary to bring to bear on the problems that beset us and the rest of mankind the benefits that surely will follow from the full development of space applications.

Of those who are skeptical of my view, I would simply ask: Had we not done the things necessary to develop these capabilities, how would the outside world look to us today? How would we look to the outside world? What would our people think of our leaders and of themselves? What would our future be?

I believe what we have done in space measures up in importance to any of the other great national accomplishments of our history. The space story, however, has another significance. There is, as suggested earlier, the matter of how as well as what. The way in which we have built up our space capabilities and what we have learned in the process about the requirements for success in such long-scale endeavors, and how well we adapt to the conditions of today may constitute as important a contribution to our Nation -- to its ability to move forward into the future -- as the space capabilities themselves.

In the NASA program, it has been demonstrated that a combination of hundreds of thousands of industry, university and government workers can coordinate their efforts successfully in the most complex of the large technical undertakings the human race has yet attempted. The fact that some 400,000 people with many varied skills have been brought together within the framework of our Nation's proven economic, social and political insitutions and have succeeded in accomplishing an extraordinarily complicated task is a matter of great consequence at a time when all nations are looking at us, and we are looking at ourselves, and asking how the other great and fateful tasks that loom so large before us will be carried out.

To do what we have done in space, we have had to learn and apply new ways of organizing and administering human and material resources. Old ways were inadequate to meet the complicated problems of melding widely varying elements into a coherent, effectively functioning enterprise that could take into account the second and third order effects of its actions, as well as the primary ones. Itis also true that the old ways are inadequate for other large and increasingly complex endeavors which the nation has no choice but to undertake. The hard fact of modern organizational life is that traditional patterns and procedures cannot meet today's needs for overcoming society's pressing problems or for keeping pace in a purposeful way with accelerating technological change.

The feature that has hitherto most strongly marked large-scale organized activity in our society has been the trend toward ever larger and more ponderous bureaucracies. This is evident in both the private and public sectors. We have seen that for many lines of endeavor bureaucracies work reasonably well. When the job is routine, or repetitive, the mechanistic approach of the bureaucracy is probably the best to use since it is both safer and surer. But where the job is new and different, where it involves coping with uncertainty and rapid change, where it requires a first use of new knowledge and new technology, where it is concerned with new and shifting demands, where it is dependent for success on highly skilled and sensitive individuals with varied types of expertise, the bureaucratic approach falls down. Its structure is almost by definition inflexible. It can, as the historian William H. McNeil has pointed out, "only do what it was built to do." It cannot be readily redirected. Its effectiveness is in almost direct ratio to the degree of stability that prevails within itself and in the surrounding environment. When pressures arise for change in either its goals, its way of doing things, or its role, the bureaucracy can hardly respond lest it destroy itself. Instead it brings to bear built-in mechanisms to neutralize the pressures whether they come from within or from without. To quote McNeil again:

> "Scientific personnel classification allows, nay, requires, interchangeability of parts in the bureaucracy; hence individual appointments and dismissals make remarkable little difference... The administrative totality, its over-all structure and functioning, and even the general lines of policy remain almost unaffected by changes of elected officials. Even energetic reformers, placed in high office and nominally put in charge of such vast bureaucratic hierarchies, find it all but impossible to do more than slightly deflect the line of march.
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> "A really massive bureaucracy...becomes a vested interest greater and more strategically located than any 'private' vested interest in the past. Such groupings are characterized by a lively sense of corporate self-interest, expressed through

> elaborate rules and precedents, and procedures rising toward the semi-sacredness of holy ritual. These buttress a safe conservatism of routine and make modern bureaucracy potentially capable of throttling back even the riotous up-thrust of social and technical change nurtured by modern science."

The type of job with which NASA was charged in the National Aeronautics and Space Act of 1958 is clearly beyond the capability of a traditional bureaucratic establishment. It requires above everything flexibility. It cannot be accomplished by an organization that is rigid either in structure or methods. It can be done only by an organization that is truly adaptive, that has the capability to deal with the unknown, to operate under conditions of rapid change in a turbulent environment, to secure and act upon instantaneous feedback from both its own performance and its environment, to use and where necessary generate new knowledge and new technology, to combine and recombine highly trained experts of differing backgrounds and disciplines, to adjust to varying levels of support, to speed up and slow down, to change directions in mid-course, to constantly improvise, invent, and innovate.

Other of the great jobs with which we as a Nation are now faced -- those related to re-making our cities, checking the deterioration of our natural environment, solving our transportation problems, ending the ravages of poverty, safeguarding our national security, and reaping for ourselves and for mankind the benefits to be gained from that continuum both within and without our national boundaries which extends from beneath the ocean floor upward and outward through the atmosphere and into space -- all of these jobs are sure to open new opportunities. They will require, just as the opening of the space age required NASA, a new and different organizational approach.

Dr. Warren G. Bennis describes this need, in terms of "adaptive, problem-solving, temporary systems of diverse specialists, linked together by coordinating executives in organic flux."

Mr. Harvey Sherman describes it in much the same way: "... the problem we now face in organization may well have changed in nature from one of adjusting organizations to meet present conditions; that is, maintaining equilibrium to one of adjusting organizations to meet future unknown conditions; that is, maintaining desired dis-equilibrium."

Some have the view that the experiences we have gained in organizing and administering the Nation's aeronautics and space programs have littled applicability to the other large, complex and difficult tasks we face. For instance, Forbes, in its space issue of July 1, voiced such skepticism:

> "Can these systems [that NASA has employed] be applied to problems other than those of space and of the military? A good deal has been said and written on the subject. Much of it is sheer propaganda, intended to justify space exploration and to try to gain a beachhead for aerospace

companies in non-aerospace businesses. Only this January, for example, an article in Fortune expounded: 'The systematic planning that built missiles and spacecraft can be used with telling effect to attack urban complexities.' The argument ran that the systems approach can be applied to earthly problems: transportation, bottlenecks, hardcore unemployment, the pollution of water and air.

"But can it? This is open to serious doubt. Space exploration deals chiefly with nature and technology -- non-human forces. The more earthly problems basically involve interrelations among people: We already know, technologically speaking, what the problems are and how to solve them. We do not know how to get people to accept the solutions or how to allocate the costs...

"... systems engineering is simply the planned, organized undertaking of unusually big, unusually complex engineering projects. A great deal can be learned from it. To oversell it, however; to promise some kind of alchemy from it -- like so much of the other overselling involved in the space program -- is a real disservice to the basic values of space exploration."

These comments, it seems to me, represent an important element in the debate now underway as to how our Nation should approach the demands of the future. I would say that they rest upon an oversimplification of the process NASA has used in organizing and administering the space program. As to the "systems approach" and its various sub-elements, such as "systems analysis," "systems engineering," and "systems management", I agree and have repeatedly emphasized that much of what is said represents myth rather than reality. These are all useful tools. They greatly increase our ability to get things done. But, as I pointed out recently in the McKinsey lectures at Columbia University, they also have their limitations and pitfalls. Any idea that they can give us an assured way to lead and manage large and complex enterprises is fanciful in the extreme.

The NASA programs have made very effective use of the systems approach. I would say that without employment of that approach, our programs could not have succeeded. But our effort has involved much more than the systems approach. Much that has contributed to the success of the space program is beyond the capability of any computer yet dreamed of. The NASA program has been an adventure into the unknown and it has had to proceed through a turbulent and unpredictable, multi-faceted environment. While it has been peculiarly dependent on computer science, it has been even more dependent on the subtleties and flexibilities brought into play by those responsible for leadership and by pressures exerted on these leaders. NASA has had to develop an ability to adapt to reality and to recognize new and emerging concepts of reality.

It is incorrect to say, as Forbes does, that space exploration deals chiefly with "nature and technology" and hence contrasts with "more earthly problems" that "basically involve interrelationships among people." Space exploration is indeed concerned with natural forces and with the technology needed to measure and use these forces. But is has required the coordinated work of 20,000 industrial enterprises, 200 universities, 400,000 highly skilled men and women, and hundreds of leading scientists, engineers, and managers. It has involved welding together many pre-existing organizations, all established under differing circumstances and for different purposes and all with their own separate practices and methods. It has involved learning to work within the framework of our representative governmental system of decision-making and under the constant glare of the TV cameras. It has involved keeping the people of the Nation and their elected representatives informed of what we were doing, and how, and to what ends. It has involved safeguarding basic values in our society and respecting its preferred ways of doing things. It has involved keeping a close weather eye out for unexpected impacts. And it has involved meeting the unending need to insure the financial support necessary to keep the whole enterprise going.

The essence of the job NASA has done is not that a new body of knowledge and technology has been brought into being. Most of the basic knowledge and basic technology was already at hand. The essence of our job has been that of organizing and managing the use of available knowledge and technology in a purposeful and effective way. This, fundamentally, has been a job of organizing and managing people and simultaneously making sure citizens and their legislative representatives were in position to understand, to accept, and to support what was being done and the purposes for which it was being done.

Here, I believe, also lies the essence of the other great undertakings that our society will have to face up to. I doubt that we will need to discover new knowledge or to invent new technology to meet urban and other pressing problems. We already have most of the knowledge and technology necessary and where deficiencies exist, they can be overcome as work programs progress. Our real need is to better organize the use of the knowledge and technology we have and to apply the increased power thus attained to those purposes we decide to pursue. The experience we have gained in NASA can surely provide more than a little guidance to those entrusted with this process.

In saying these things, I am not seeking, as some may contend, new assignments for NASA or added work for the aerospace industry. I am not suggesting that those of us who have engaged in the aeronautics and space programs should be entrusted with other great tasks. My thought instead is that NASA's experiences -- its failures as well as its successes -- can help in the critically needed development of a proven way to organize and administer large and complex enterprises. These enterprises by their very nature require enormous investments of human and material resources; they also require the concentration of great power in the hands of a few individuals. The costs of failures and abuses can be immense. Society needs as much assurance of success as it can have when it commits its resources in large amounts to large undertakings. And it needs assurances that the leaders involved will use the resources and the accompanying powers to strengthen, and not to weaken, valuable existing institutions and groupings in the Nation's economic, social and political structure.

A great difficulty that complicates organizing and carrying out large enterprises under present conditions is that the issues involved are often so complex that the average citizen cannot understand them. Out moderator today, Dean Don Price, in his recent book entitled The Scientific Estate underscores the seriousness of this situation. In his words:

> "The industrial revolution brought its complexities, and relied heavily on new forms of expertise, but it did not challenge the assumption thatthe owner or manager, even without scientific knowledge, was able to control the policies of a business. And the same general belief was fundamental to our governmental system: the key ideas, if not the lesser details, could be understood by the legislature and debated before the public, and thus controlled by a chain of public responsibility. In one sense this was

never true. But it is much less apparently true today than it was, and a great many more people doubt it. The great issues of life and death, many people fear, are now so technically abstruse that they must be decided in secret by the few who have the ability to understand scientific complexities. We were already worrying about the alleged predominance of the executive over the legislature; now we worry lest even our elected executives cannot really understand what they are doing, lest they are only a facade that conceals the power of the scientists -- many of whom are not even fulltime officials, but have a primary loyalty to some university or corporation -- who really control the decisions... Science has thus given our political evolution a reverse twist. It has brought us back to a set of political problems that we thought we had disposed of forever by simple Constitutional principles."

These are sobering considerations. Some might say that they logically lead to the conclusion that our democratic system must be modified, that it must give way to some kind of absolutist set-up, perhaps some sort of technocracy. In my view the answer is quite different. I see as the answer the experimental development of a proven or low-risk way to carry forward large and complex and technologically advanced enterprises; a way that will engender trust and confidence on the part of citizens even when they cannot fully comprehend all the nuances of the enterprises or see clearly what all their consequences will be. Such a proven and trusted way, it seems to me, requires a willingness and ability of those responsible for the enterprises to keep constantly in view the relationship between their undertakings and the totality of the needs and interests of the Nation at any given moment; to adjust readily to changing conditions and changing requirements; to accept and work effectively within the restraints imposed by our representative system; to utilize wherever possible existing institutions and establishments in a manner to strengthen rather than weaken the values they represent; to take into account the second and third order effects of their decisions and actions; to operate to the fullest extent possible in the open and subject to public scrutiny; and to report in understandable terms whether or not an enterprise is accomplishing what it was set up to do. Further, they should evaluate and report as to whether or not the accomplishments are worth what they are costing. They should do this when the public wants to know and not just when the leadership itself wishes to report.

No single endeavor in which this Nation has so far engaged has equalled the NASA aeronautical and space programs in complexity. Few have involved so many unknowns and uncertainties, or have been so dependent for success on the "mysteries" of science and advanced technology. Few have presented as wide a range of problems in organization and management. And fewer still have held such popular interest; been subject to such public examination; and required such a unique degree of faith and trust on the part of the public.

Let me review for a moment in more specific terms some of the characteristics that have distinguished these programs. Seven immediately stand out.

First, the program has had multiple objectives. On the one side, and as we must acknowledge in all frankness, was the matter of speed in restoring the technological-strategic balance that had been upset by the USSR with its Sputnik. The initial issue here, as you may well recall, was "to do something now" to offset the advanatage the Soviets had gained. Related to this was the more far-reaching and fundamental objective of developing the basic capabilities necessary for us to reach up through the earth's atmosphere and to become "a spacefaring nation second to none," to attain "preeminence in space." Then there were a variety of particular assignments, all inter-related but each of importance in itself: (a) to study the space environment by scientific instruments involving the use of sounding rockets, earth satellites, and deep space probes; (b) to begin the exploration of space by man himself; (c) to search for extraterrestrial life and thus find out whether we are alone in this vast universe; (d) to apply space science and technology for peaceful purposes to promote human welfare; and (e) to expand space science and technology as a basis for assuring national defense and welfare.

Second, the program has required working at the frontiers of knowledge and technology and has involved the construction of facilities and equipment, much of it without precedent. For much of the ten years of its life, NASA has found itself facing problems for which no solution was available. It has had to rely upon men and women with special, often unique skills, with high intelligence and creativity, individuals who by their very nature raise difficult problems of organization and management. Experts from the whole range of disciplines from astronomy through zoology have been required. Most tasks have needed more than a multi-disciplinary effort -- in effect, a fusing of disciplines. New kinds of facilities had to be provided, running all the way from the two million square foot Michoud booster assembly facility to vacuum chambers, centrifuges and other machines to simulate the hard vacuum and other extreme conditions of outer space. These varying, unique, and interrelated requirements for personnel and new kinds of facilities have greatly complicated the tasks of organization and management.

A third distinguishing characteristic of NASA's assignment is the long lead times required. This factor of long lead times, coupled with uncertainties and rapidly evolving technologies has added many complexities to the task of organizing the effort. A span of years is often required from the conception of a new space mission until the launch vehicle, the payload and attendant facilities are designed, built, tested, launched, and the resulting data returned. Meanwhile, some early assumptions have been revised or new knowledge or technology has generated substantial alteration. This characteristic of space missions places a major premium on realism in planning and replanning and on grouping and regrouping of resources. Experience must reflect back into what is going on and what is planned for the future. The long lead times also mean that a substantial period will always exist between public investments and visible major payoffs. This factor compounds and complicates the difficulties of securing continuing support.

Fourth, a high order of reliability is an absolute necessity. Cost, public concern over each mission, and the risks to human life have combined to create a demand for a degree of reliability seldom required in other fields. The imaginative concepts of scientists and engineers, and the unique equipment which they have developed have necessitated a wide use of simulation techniques. The ability to simulate complex environments and their interrelationships to complex machines and instruments has been developed almost to the level of a science. The use of simulation and testing now assures a high degree of reliability, but this must be obtained within much tighter time schedules than has historically been the case in complex research and development undertakings. There is little room for trial and error. In space, a system of utmost complexity must work at near perfection the first time it is put into operation if a serious setback is to be avoided. There are few "second chances" in space.

A fifth distinguishing characteristic is that under the provisions we have established, space missions are carried on under the persistent and exacting scrutiny of the mass media, the public, the Congress, the scientific community, and friends and foes at home and abroad. Space missions, which are the final test of much of our work, have been and will almost certainly continue to be front page news. Those engaged in these tasks work in a goldfish bowl and are expected to interpret, explain, and defend in detail what they are doing and why they are doing it.

Sixth, aeronautical and space programs are peculiarly and intricately interrelated with the state of public sentiment or concern -- the political environment or mood. A significant change in this environment -- the Soviet breakthrough with Sputnik -- sparked the initiation of the program. Such developments as the new political situation of 1961, the ups and downs in international activities, shifting views as to Soviet intentions and purposes, Congressional and popular reaction to the Apollo fire of January 1967, popular concern over the outbreak of a riot or a seemingly bad turn in the situation in Viet-Nam place on NASA a critically important need for flexibility in organizational structure and management processes in order to adjust to new situations and demands. NASA's programs have always been peculiarly dependent on confidence that a continuing "critical mass" of support will exist. As with an airplane, these programs must have initial support adequate to attain the equivalent of "flying speed," and sufficient support must continue to maintain the airplane's equivalent of an efficient flight pattern. NASA's space programs, in turn, have had and will continue to have an important impact on public sentiment. Some effects have been direct and immediate, as when measurements made by spacecraft reach the scientific community, or contracts modify the economic and employment situation in a city or state, or the stimulation of technological innovation changes practices in industry, medicine, communications, weather services, transportation, etc. Other effects are secondary and tertiary in nature and tend to alter attitudes, as when millions of people acquire new concepts of motion, or time, or the place of man in the vastness of space.

The seventh and final distinguishing characteristic of NASA's program on which I would place special emphasis follows from those I have already noted. It is the crucial role that feedback and quick response to feedback signals must play in every phase of planning and operation. For NASA, as for other complex endeavors which are contained in a turbulent environment, a high degree of disequilibrium is essential if the maneuverability necessary to maintain control is to be maintained. Yet the forces of disequilibrium must at all times be within the power to control and thus maneuver. Therefore, sufficient real-time feedback from substantive and administrative activities must be available to signal unexpected difficulties, or incipient failure, or emerging opportunities. This feedback, these signals must be in a form that those responsible for control can respond and make quick changes of course. Enormous amounts of information have to be generated, but information alone is not enough. Means have to be devised and employed to sift from a mass of disparate data that which is needed at any given moment and to deliver it at that moment to the critical point of decision. A further requirement is speed in decisions and in the implementation of decisions. Such a feedback and response system, it should be emphasized, is necessary not only for operations within the NASA program itself. The need extends to the relevant features of the outside environment in which those operations take place.

While these, and other, special characteristics have distinguished the NASA programs from routine endeavors, they can hardly be considered unique. Similar characteristics have to be faced up to and dealt with whenever the nation undertakes a task of unusual complexity requiring concentration of large and diverse human and material resources and which involves the use of new knowledge and advanced technology. Moreover, until we bring ourselves to anticipate and act upon difficult problems in advance of a crisis situation, performance of these tasks will require working under conditions of great stress and strain.

In the case of NASA, during the first years, work had to proceed under conditions where the agency (a) was being organized from components of government agencies already in existence, (b) was instituting large new programs to increase our national capability in both aeronautics and space and at the same time was carrying forward those that had been started in constituent units, and (c) was undertaking the large buildup of manned space flight capability called for by President Kennedy's message to the Congress in May 1961. All this had to go forward against the background of great impatience on the part of many people and their elected representatives.

The easiest course that we could have followed would have been to put the program on a crash basis. There was ample precedent for such an approach, and the spirit of the country was certainly tolerant -- one might even say demanding -- of this. We could have aggregated personnel and other resources in a giant monolithic organization, scoured the country for scientists and engineers to incorporate into the organization, built massive new government installations, created our own construction units to build the test and launch facilities, and so on. We could have demanded that the entire program be put on the highest priority basis and commandeered elements of key industries. We could have focused our energies and resources on the achievement in the shortest possible time of a number of space spectaculars that would "take the heat off" ourselves and the nation.

NASA, however, did not adopt this course. We wanted to get moving toward space preeminence as quickly as feasible. But we also wanted to build soundly and for the long term as well as the short. We wanted not simply to get into space, but to achieve a well-rounded and lasting capability that would enable us to do the wide variety of things that we knew would soon become possible. Above all, we wanted the country and its institutions to be the stronger and not the weaker in consequence of our engagement in the space endeavor.

It was against this background, and not against the background of winning a race at any cost, that we charted our course in the early days. And it has been against this background that we have proceeded since. And this includes our most recent decisions and actions in response to budgetary constraints and my own retirement under circumstances calculated to insure continuity and strength in the agency's senior management group.

It may be of value to leaders in other endeavors, and to scholars, to note some of the more key actions taken by NASA to adapt to all the conditions it has faced. NASA has had the benefit of a farsighted legislative base. The National Aeronautics and Space Act of 1958 is in many ways an outstanding legislative achievement. It followed intensive studies and consultations within and outside the government on all aspects of the space question, as well as of what we had done in the past to meet similar situations. It recognized that technology would have to precede science for success in many space endeavors. It also recognized that both general and security needs could be served by developments in space and it provided for a division of labor between civilian agencies and the Department of Defense. It carried forward the concepts of the atoms for peace program, but did not require that work go forward through an international organization. It called for operations in the open and the inclusion of the scientific ommunity in the planning, conduct, and reporting of work. It brought the continuum of the atmosphere and the continuum of space together in a single research and development program. On the administrative side, the Act returned to the principle established in the Constitution of reliance on a single executive rather than on a board, commission, or council. At the same time, it freed the agency of some of the restraints of existing Civil Service regulations. And it avoided any hard and fast provisions regarding choice of missions, organizational structure and operational procedures, thus leaving the way open for NASA and its executives to be as adaptive as the requirements of the space job and the rapidly changing circumstances might require.

I should also point out that within the Congress many of the ablest and most experienced and influential of its members were deeply concerned with the space program and its success. In my years of government experience I have learned that no factor can contribute more to the success of an undertaking than for its elements to have the trust, confidence, and support of wise and strong leaders in Congress. That NASA enjoyed such support also greatly contributed to its ability to follow an adaptive course.

It is hard to judge which of NASA's particular experiences should have special emphasis as we look to the challenges of the future.

I obviously cannot go into full details. Moreover, a great deal of research and study by trained specialists will be required to form reliable judgments. I would like to indicate, however, some of the things I feel merit special attention.

One matter that is little understood is the importance of the choice of the lunar landing mission as a means of unifying and integrating into a single workable system the varied goals and the widely separated problems that marked the early years of the space program.

I have already mentioned the multiplicity of objectives that were set and the range of disparate tasks that were assigned to NASA in early 1961. I have also noted the diversity of organizational elements that went to make up NASA. No new agency in the history of the Executive Branch of the Federal Government was created through the transfer of so many units from other departments and agencies as was the case with NASA. These agencies were already engaged in a large number of ongoing developmental programs and projects, each with its special purposes and its special supporting theories and concepts, as well as its special vested interests. There were, also, many differing schools of thought as to what would best serve our nation's needs in space, and there were strong-willed and influential champions of each of those schools.

Under these conditions, our decision was to set for ourselves a number of missions, including, of course, the Apollo lunar mission, that were sufficiently challenging, and sufficiently complex and difficult in scientific, technological and administrative requirements, as to furnish in total a balanced science and technology development program. In effect, we established a focal point around which could be organized in a purposeful and coordinated way a range of activities that would collectively give us both the general and specific capabilities needed for the attainment of national preeminence.

Dr. Hugh Dryden, who served as Deputy Administrator of NASA from its establishment in 1958 until his death in December 1965, summarized in June 1961 the considerations that underlay our Apollo decision. He wrote:

> "The setting of the difficult goal of landing a man on the moon and return to Earth has the highly important role of accelerating the development of space science and technology, motivating the scientists and engineers who are engaged in this effort to move forward with urgency, and integrating their efforts in a way that cannot be accomplished by a disconnected series of research investigations in the several fields. It is important to realize, however, that the real values and purposes are not in the mere accomplishment of man setting foot on the moon, but rather in the great cooperative national effort in the development of science and technology which is stimulated by this goal. ... The national enterprise involved in the goal of manned lunar landing and return within the decade is an activity

of critical impact on the future of this nation as an industrial and military power, and as a leader of a free world."

In singling out the lunar decision for emphasis here, I do not mean to suggest that something similar to a "moon goal" is needed or will work for other large and complex undertakings. I do believe, however, that for success in such undertakings the same sort of approach that we followed and which resulted in selection of the moon goal is necessary. I believe, more specifically, that it is necessary to make the most careful analysis of all known needs at the start, to fix on a goal or set of goals that will encompass all of these needs and at the same time make adequate allowances for unknown factors and unexpected developments. It is necessary to establish an organizational and operational plan that will, on the one hand, enable the carrying out of diverse activities directed to purposefully correlated ends. It is also necessary to insure that adjustments to reality can be made when conditions turn out differently from those anticipated.

Can this kind of experience help us face the problems of our urban centers? To save our cities we at least need to meet transportation needs, housing needs, human relations needs, health needs, education and employability needs, and waste disposal needs, of air and water pollution, of crime control, and on down the well-known list. To attack each of these problems individually, as we seem intent on doing is not likely to meet the total need. To view them and their possible solutions as interdependent elements in a single whole and adopt an integrated approach in organizing ourselves to deal with them presents stupendous difficulties. I believe that for our cities, as for the space exploration, such an integrated approach will prove vastly more effective than any "individual components" approach.

A second area of NASA experience that I feel worthy of note has to do with organizational arrangements. Prior to NASA's establishment, activities related to space research and development were carried on in a number of government departments and agencies. These activities were quite productive, surprisingly so in a number of instances. Nevertheless, and understandably, once the full impact of Sputnik was felt, the Nation became impatient of the results of these uncoordinated efforts. And, as seems to be more or less customary under such circumstances, an entirely new agency -- NASA -- was brought into being to get a critical job done.

Under its legislative charter, and particularly after the 1961 decision for a greatly expanded and accelerated space effort, NASA could have proceeded with the buildup of a large and highly centralized department-like structure. This would have been the more or less normal thing to do, and as noted earlier, it would have been the easiest from the strictly administrative standpoint. But the NASA program was too complex -- its requirements extended over too wide a range of the nation's competence -- to draw into the confines of a single organization all or even most of the expertise needed. We could have tried this, but instead we adopted the policy in the performance of our work of utilizing to the maximum feasible existing organizations and institutions. This operated to spread our problems over the largest number of able minds and to draw upon the range of the nation's scientific and industrial competence in the locations where it existed.

This policy was applied in the first instance to the laboratories, research and development centers, and other installations transferred to NASA from other government agencies. These establishments were left in place and allowed a large degree of operational and administrative autonomy. They were delegated contractual authority up to $5 million, subject to central review. Where we have found it necessary to add to our in-house capabilities, we have done so not through expanding NASA's central headquarters in Washington, but through strengthening and adding to regional centers. Employment in Washington has never exceeded 2500. This contrasts with a peak of some 33,000 in the regional establishments and a total work force of 420,000.

We have also made extensive use of the manpower and facilities available in other government agencies. We have, for example, turned to the U.S. Army Corps of Engineers to manage our construction programs, which required, at its peak, a work force of 40,000 men and women, and represents a capital investment of $3 billion. We have similarly relied on other specialized units of the Department of Defense, the

Bureau of Standards, the Weather Bureau, and many others for much of our research and development. We have been assisted on many problems by the National Science Foundation. And we have borrowed from other agencies, and particularly from the Armed Services, many of those who have manned and directed our various projects.

A major NASA policy has been to rely on contracts with non-governmental establishments and institutions for the work they were qualified to do. Over ninety percent of all funds invested in the NASA program have been spent outside the government. In some years this has reached 95%. Principal reliance has, of course, been placed on industry, but we have also drawn heavily on universities and such private organizations as the National Academy of Sciences, the National Academy of Engineering, the National Academy of Public Administration, and a long list of others.

Seldom in history has a large and complex undertaking been so widely spread over existing organizations and institutions as has been the case with NASA. I might repeat here some figures I mentioned earlier: The NASA program has involved about 20,000 industrial prime and sub-contractors and suppliers, 200 universities, and almost 400,000 non-governmental workers.

The spreading of NASA's work load over such a large number of elements has forced us to extend into new dimensions the art and practice of administration and mangement. The NASA program has been not only large; it has been extremely complex. While it could not have been carried forward successfully without the resources represented by our nation's industrial establishments and universities, it also could not have been carried forward without strong in-house capabilities within NASA and within the cooperating government agencies.

This brings me to an essential corollary of our policy of maximum utilization of outside resources. For a complex, large scale undertaking, it is necessary to have within the responsible organization itself enough capability -- scientific, managerial, and engineering -- to plan and administer, to watch over and assist the research and development work being done by others. It is not possible to rely upon even the most complex contracting system where accountants and lawyers are the prime reliance for performance. In NASA we have found that we must be able to speak and understand the language of those on whom we rely, to know as much about the problems they are dealing with as they do, to check and supplement their work in our own laboratories, to step in when required with the necessary specialists and, in some cases, help untangle snarled situations. In other words, we have to learn to be active participants in all phases of the projects that we entrust to others without undermining their own discipline and control.

What is the significance of such organizational arrangements? I would say simply this: Our society cannot afford the creation of one massive organization after another to cope with every new, complex situation that arises. We cannot continue the practice of "government by crisis." We must equip ourselves to deal with the large and the difficult and the complex in a regularized way. We must develop and systematize methods and procedures whereby we can combine, dismantle and recombine elements of existing establishments in and outside of government to get big and increasingly complex jobs done. We must learn how to marshall and focus the great resources available in our established organizations and institutions to shifting "points of main impact." This must be accomplished without disruption of those organizations and institutions or dimunition of their ability to perform the other tasks with which they are concerned. And we must accustom ourselves to the regular use of such an approach.

There are numerous other aspects of our NASA experiences that merit attention but on which I can only touch today. A particularly important one is that as we have used industry and universities and other institutions to carry the main burden of the NASA work program, we have as a matter of deliberate policy done so in a way to strengthen rather than weaken these basic elements of our society. With respect to industry, we have been willing to pay a fair price, including a fair profit, for work done, including research and development that would not lead to follow-up production work. We have employed incentive contracts. We have encouraged and stimulated the utilization by industry of the latest technology. We have assisted in development of new capabilities within existing enterprises.

For universities, we have taken many steps that encourage research on the campus, rather than encouragement for the researcher to leave the campus. This has aided teaching and graduate training. We have provided doctoral training support for several thousand scientists and engineers. We have assisted in the construction on the campus of new laboratories and other research and training facilities. We have done all we could to encourage improvement: in both curriculum and program and to stimulate the melding of disciplinees so as to increase the capabilities of universities and their graduates to deal with modern day problems. We have endeavored to help universities become "trusted sources of knowledge" in our society. And we have notlimited ourselves to a few great universities. We have also worked closely with less well known universities when these could demonstrate merit or promise of merit. We have done this in order to get all of the help we could in the performance of our difficult tasks and at the same time to stimulate the further development and extension of the higher educational resources of the country in areas related to our missions.

Our overall aim has been to effect a mutually beneficial working partnership between the universities, industry and the government. We have operated on the principle that there is no inherent quarrel between public and private purposes but that there is instead a coincidence of interest which offers a sound basis for genuine teamwork to the benefit of both sides and indeed of our society as a whole.

NASA has also concerned itself with other impacts that its program and activities have had or may have on society. We have been concerned not alone with prime effects, but with second and third order effects as well. I must acknowledge that our understanding of this matter of second and third order effects and how to control them to desired ends is as yet rudimentary. But we have learned enough to appreciate that closest attention must be paid to them, and particularly as they relate to society's basic institutions and values.

In NASA we have had a great deal of experience with such things as management information systems, the multiple executive, the concept of a strong executive secretariat, decentralized management, functional management, project management, program management, institutional management, new methods in contracting, self-policing systems, and so on. These experiences are too numerous to cover today. I can only express my view that they are deserving of investigation and study, both the successes and failures. This year, we have started to experiment with the computer storage and retrieval of all information in our central files, with remote access units. In time, this should make the work of scholars wishing to use our records for research somewhat easier.

A last matter that I would touch upon with you today is our experiences with regard to the changing tempo and scale of the NASA operation.

At the inception of the enlarged space effort in 1961, it was clear that the NASA assignment would be an evolving one. We saw the probability of four major stages: First, a period of rapid buildup of capabilities and facilities, during which maximal inputs of resources and manpower would be required; _second_, a period of leveling off, or maturing, during which emphasis would shift from the development of capabilities to the use of capabilities already created and during which there would be a decline of new inputs of resources and manpower; _third_, a period of transition preparatory to putting the space endeavor on a long haul or regularized basis; and _fourth_, a period, extending over the indefinite future, during which space explorations and activities would be carried on as a normal and more or less routine part of our national life.

We recognized that each of these stages would require essentially different organizational and administrative systems and procedures, and that it was important that we avoid freezing ourselves into any set pattern during any one stage, short at least of the final one of regularized activity. We have consequently not only kept the NASA administrative structure flexible, we have made a practice of regularly structuring it in whole and in its several parts. We have, as a matter of fact, used structural reorganization as an important administrative device. We have sought, in other words, "desired disequilibrium" as necessary to meet both the complex requirements of today and the unknown requirements of the future.

We have also recognized that in the project-type endeavor, acceleration would have to be followed by deceleration and that many operations involving both governmental and non-governmental manpower and facilities would have only a limited usefulness. We have accepted the need to end these after their purposes had been met. In other words, we foresaw that the NASA program would involve areas of declining activity as well as areas where newly-approved projects were building up.

We have already, as I have said, reduced the scale of our total activities to about one-half the peak level, which was attained three years ago. The construction program is largely completed, which means that our research and development programs are now at about two-thirds of the peak. We are in position to operate at this level or to increase or decrease as decisions generate either trend. We have made corresponding organizational and administrative changes. These adjustments have been carried out in a forward-looking way, and they leave both NASA and the space program in as good order as is possible under the circumstances.

We have been able to adapt to a series of drastic reductions in NASA's activities.

No one thing, it seems to me, is as important in gaining acceptance for the use of large and complex endeavors to get big and special jobs done as the demonstration of a capacity for the orderly phasing down of activities if the early momentum cannot continue. Organizations, private as well as public, have a way of generating dynamics to keep themselves going or even to increase the scope of their activities. This is perhaps one reason why citizens generally resist the initiation of special efforts to meet difficult problems until there is a fullblown crisis. And here, I believe the instincts of our citizens are in part sound. We cannot afford to continuously add self-perpetuating organizations to our governmental structure. But there is another side to the story: We also cannot afford to dismantle and scrap effective organizations that have been built up at great cost each time a special job is finished. We particularly cannot afford this when the organizations in question are capable of initiating and leading the new technological developments essential for the continued advancement of our society.

How is our Nation to deal with this dilemma? We all need to give it much attention and study. As a possible contribution, I would offer in closing the thought that progress can be encouraged through a better understanding of what is needed for governmental elements to effectively adapt to changing conditions, to be able to reorganize and regroup components and units as problems and situations and opportunities change. Such an ability to adapt, to restructure, will require important legislative changes as well as strong leadership in the Executive Branch. For both, a better base of knowledge as to what produces success or failure is needed.

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